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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/618,636

07/15/2003

John MacNeil

WLJ.070D

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03/16/2006

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EXAMINER

PHAM, THANHHA S

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 03/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/618,636

Applicant(s)

MACNEIL ET AL.

Examiner

Thanhha Pham

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 10, 11, 13 and 17-28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 10-11, 13, 17-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☐ Certified copies of the priority documents have been received.
 - 2) ☒ Certified copies of the priority documents have been received in Application No. 09/760,820.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This Office Action is in response to Applicant's Response to Restriction Requirement dated 10/17/2005.

Election/Restrictions

1. In regarding to Applicant's arguments that species A & B are simply verbatim citations, after considering carefully Applicant's specification, since specification does not specify specific contribution/concentration of nitrogen and carbon in a layer to define the "carbon doped silicon nitride SiN(C)" and the "nitrogen doped silicon carbide SiC(N)" (even though specification page 7 mentions that SiC(N) having a $k=2.6$ and $\text{SiC(N)}=4.6$), Examiner withdraws Restriction Requirement to species on 10/03/05. For the purpose of examination, the "carbon doped silicon nitride" and the "nitrogen doped silicon carbide" are considered as names of a layer of material comprising components of silicon, carbon and nitrogen.

Specification

The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

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- (a) TITLE OF THE INVENTION.
- (b) CROSS-REFERENCE TO RELATED APPLICATIONS.
- (c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
- (d) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC (See 37 CFR 1.52(e)(5) and MPEP 608.05. Computer program listings (37 CFR 1.96(c)), "Sequence Listings" (37 CFR 1.821(c)), and tables having more than 50 pages of text are permitted to be submitted on compact discs.) or REFERENCE TO A "MICROFICHE APPENDIX" (See MPEP § 608.05(a). "Microfiche Appendices" were accepted by the Office until March 1, 2001.)
- (e) BACKGROUND OF THE INVENTION.
 - (1) Field of the Invention.
 - (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
- (f) BRIEF SUMMARY OF THE INVENTION.
- (g) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
- (h) DETAILED DESCRIPTION OF THE INVENTION.
- (i) CLAIM OR CLAIMS (commencing on a separate sheet).
- (j) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
- (k) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

2. The disclosure is objected to because of informalities. Appropriate corrections are required:

- Specification should include sections in order as being set forth by 37 CFR 1.77(b) wherein each of the lettered items should appear in upper case, without underlining or bold type, as a section heading.
- Specification pages 11-13 are objected. Examiner respectfully requires Applicant to clarify why specification page 11 lines 16-23 is contradict to specification page 13 lines 6-11 (Examiner assumes that layer "11" with a typographical error should be the layer 10 – fig 5a for details) -- As to specification page 11 of line 16-23, the "trench first"

with the faster etching SiO₂(C) 13 is overlying a slower etching layer 10. Examiner can not understand why specification of page 13 mentions the layer 10 has an etch rate higher than the layer 13.

► Specification page 12, (as being best understood by Examiner)

line 18, "the via formation 11" should be changed to "the via formation 12"

► Specification page 13, (as being best understood by Examiner)

line 4, "the layer 11" should be changed to "the layer 10"

lines 7-8, "the layers 13 and 11" should be changed to "the layers 13 and 10"

lines 10-11, "material 11" should be changed to "material 10"

line 12, "material 11" should be changed to "material 10".

Drawings

3. The drawings are objected to under 37 CFR 1.83(a) because they fail to show references 11, 10 and 13 as described in the specification page 13. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be

removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "11" and "10" in fig 5(b) have both been used to designate the first layer of low-k insulating material as in description of fig 5(a). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

5. Claim 10 is objected to because of informalities. Appropriate correction is required to clarify scope of claim.

- ▶ With respect to claim 10,
line 7, “the materials” should be changed to “the first material and the second material” to clarify scope of claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 10-11 are rejected under 35 U.S.C. 102(e) as being anticipated by Bjorkman et al. [US 6,340,435].

- ▶ With respect to claim 10, Bjorkman et al. (fig. 2A, abstract, cols. 2-6) discloses the claimed stack of dielectric layers (42/40, col. 7 lines 45-67 and col 8-9) located over the surface of a substrate (50/48/46) and comprising a first dielectric layer (42) formed of a first material having a first etch rate and a second dielectric layer (40) formed of a second material having a second etch rate, wherein the first dielectric layer (42) is interposed between the surface of the substrate (50/48/46) and the second dielectric (40), wherein the first material is different than the second material (col 7 lines 45-67:

the first material is different than the second material since the first material of layer 42 contains less amounts of carbon or hydrogen than the second material of layer 40), wherein the first material and the second material have detectably different etch characteristics (col 7 lines 45-57: the first material 42 has an etch rate at least 3 times greater an etch rate of the second material 40) but generally equal dielectric constants (both of the first material and the second material are low-k dielectric materials with dielectric constants less than 3), wherein the first etch rate is greater than the second etch rate (col 7 lines 45-57).

- ▶ With respect to claim 11, Bojorkman et al. (col. 7 lines 45-57) discloses wherein the ratio of the first etch rate to the second etch rate is at least 2.5:1.
- ▶ With respect to claim 20, Bojorkmamn et al (col 7 lines 58-67, col 8 lines 1-7 & col 10 lines 55-65) discloses wherein a dielectric constant of each of the first and second materials is less than 3.5 (3.0 or less).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 13, 17 and 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bojorkman et al [US 6,340,435].

- ▶ With respect to claims 13 and 21, the claimed range of difference between the dielectric constants of the first and second materials would have been obvious to an

ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, it appears that these changes produce no functional differences and therefore would have been obvious. See *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

► With respect to claims 17 and 22, the claimed range ratio of the first etch rate to the second etch rate would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Furthermore, it appears that these changes produce no functional differences and therefore would have been obvious. See *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). In addition, a recitation of the intended use of the claimed invention (using the stack of dielectric layers in condition of etching such that the ratio of the first etch rate of the first material to the second etch rate of the second material being between 2:2 and 3:1) must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

3. Claims 18-19, 23-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bjorkman et al [US 6,340,435] in view Chooi et al [US 6,436,824].

► With respect to claims 18-19, 23 and 26, Bjorkman et al substantially discloses the claimed stack of dielectric layers comprising the carbon-doped SiO₂ dielectric layer (42, low dielectric constant of less than 3) of the first dielectric layer having the first etch rate and the second dielectric layer (40) having the second etch rate wherein the first dielectric layer and the second dielectric layer have detectably different etch characteristics but generally equal dielectric constants wherein the first etch rate is greater than the second etch rate. Bjorkman et al teaches the second dielectric layer as an etchstop layer for the stack of dielectric layers for formation of dual damascene in semiconductor or IC. Bjorkman et al does not teach the second dielectric layer being of a carbon-doped silicon nitride *[claims 18 & 23]* or a nitrogen-doped SiC *[claims 18 & 26]* which is the dielectric layer comprising silicon, carbon and nitrogen.

However, the dielectric layer comprising silicon, carbon and nitrogen is a known dielectric material with low-k constant for etchstop layer that has been used for the stack of dielectric layers in formation of dual damascene. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last

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opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious).

Moreover, Chooi et al (fig 2, cols1-5 -- particularly col 2 lines 59-62 col 4 lines 59-67 & col 5 lines 1-9) teach the second dielectric layer (20) comprising silicon, carbon and nitrogen as an good etchstop material with low-k dielectric (e.g. k is about 3) in the stack of dielectric layers for dual damascene formation in semiconductor or IC.

Therefore, at the time of invention, it would have been obvious for those skilled in the art, in view of Chooi et al, to use the second dielectric layer comprising the second material as being claimed as the known material for etchstop in the stack of dielectric layers of Bjorkman et al to provide a good barrier layer using in dual damascene of semiconductor device or IC (see Chooi et al, col 4 lines 59-67 and col 5 lines 1-8 for details).

► With respect to claims 24-25 and 27-28, the claimed ranges of dielectric constants of the carbon-doped SiO₂ and the dielectric layer comprising silicon, carbon & nitrogen (carbon-doped silicon nitride or nitrogen-doped SiC) and the claimed ranges of differences dielectric constant of the carbon-doped SiO₂ relative to the dielectric layer comprising silicon, carbon & nitrogen (carbon-doped silicon nitride or nitrogen-doped SiC) would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. *In re*

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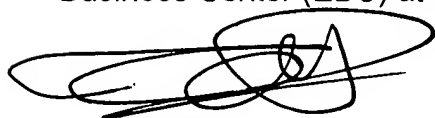
Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, it appears that these changes produce no functional differences and therefore would have been obvious. See *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to be 'Thanhha Pham', with a large, stylized flourish at the end.

Thanhha Pham

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Patent Examiner

Patent Examining Group 2800